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H. S. Grindley

Columbia University in the City of New York

SCHOOL OF CHEMISTRY

ANNOUNCEMENT

1898–99

NOTE

COLUMBIA UNIVERSITY offers the following courses:

In COLUMBIA COLLEGE:
A four-years' course leading to the degree of . . . . . A.B.

In the SCHOOL OF LAW:
A three-years' course leading to the degree of . . . . . LL.B.

In the SCHOOL OF MEDICINE (College of Physicians and Surgeons):
A four-years' course leading to the degree of . . . . . M.D.

In the SCHOOL OF MINES:
A four-years' course in Mining Engineering leading to the degree of E.M.
" " Mining and Geology " " E.M.
" " Metallurgy " " Met.E.

In the SCHOOL OF CHEMISTRY:
A four-years' course in Analytical Chemistry leading to the degree of B.S.
" " Industrial Chemistry " " B.S.
" " Organic Chemistry " " B.S.

In the SCHOOL OF ENGINEERING:
A four-years' course in Civil Engineering leading to the degree of C.E.
" " Sanitary Engineering " " C.E.
" " Electrical Engineering " " E.E.
" " Mechanical Engineering " " Mech.E.

In the SCHOOL OF ARCHITECTURE:
A four-years' course in Architecture leading to the degree of . B.S.

In TEACHERS COLLEGE:
Certain courses that are accepted in partial fulfilment of the requirements for the degrees of A.B., A.M., and Ph.D.; besides various courses leading to the Teachers College diploma.

Also many courses under the various faculties, especially the Faculties of Philosophy, Political Science, Pure Science, and Applied Science, leading to the university degrees of Master of Arts and Doctor of Philosophy. A combination of courses under the Faculties of Law and Political Science leads to the degree of Master of Laws.

The first-year courses of the School of Law, the School of Medicine, the School of Mines, the School of Chemistry, the School of Engineering, and the School of Architecture are open, as electives, to Seniors in the College who have become students of the College not later than the Junior year. Consequently such Seniors can prepare themselves for advanced standing in these schools by electing these first-year courses and counting them for the degree of Bachelor of Arts.

By a judicious arrangement of his course from the beginning, a student in the College may complete his college and professional course together, in the Schools of Law and of Applied Science in six years, and in the School of Medicine in seven years.

In addition to the regular courses that lead to the various degrees, Columbia University, in order to meet the needs of persons who wish to make a serious study of any special branch of knowledge, offers to them, according to their stage of advancement, special courses in Philosophy, in History, in Literature and the Languages, and, under certain restrictions, in Pure and Applied Science. For admission to any one of these special courses, the student must show that he is competent to take the course. On the completion of such special course a certificate will be granted by the faculty under which his principal subject lies.

Information and circulars as to any of the above courses may be had by addressing the Secretary of the University.

The catalogue of the University is published in December, and is sold at twenty-five cents a copy.

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OFFICERS

Seth Low, LL.D., *President*
Henry S. Munroe, E.M., Ph.D., *Dean of the Faculty*

Officers of the Chemical Department

Charles F. Chandler, Ph.D., M.D., LL.D., *Professor of Chemistry*
Pierre de Peyster Ricketts, E.M., Ph.D., *Professor of Analytical Chemistry and Assaying*
Charles E. Pellew, E.M., *Adjunct Professor of Chemistry*
James S. C. Wells, Ph.D., *Instructor in Analytical Chemistry*
Hermann T. Vulté, Ph.D., *Instructor in Chemistry*
Edmund H. Miller, Ph.D., *Instructor in Analytical Chemistry and Assaying*
Marston Taylor Bogert, A.B., Ph.B., *Instructor in Organic Chemistry*
Louis H. Laudy, Ph.D., *Tutor in Chemistry*
Samuel A. Tucker, Ph.B., *Tutor in Industrial Chemistry*
J. Livingston Rutgers Morgan, B.Sc., Ph.D., *Tutor in Chemical Philosophy and Chemical Physics*
John Alexander Mathews, A.M., M.S., *Tutor in General Chemistry*
Milton C. Whitaker, B.S., *Tutor in General Chemistry*
Charles H. Fulton, E.M., *Assistant in Analytical Chemistry*
Henry C. Sherman, Ph.D., *Assistant in Analytical Chemistry*
Cavalier Hargrave Jouët, Ph.D., *Assistant in Analytical Chemistry*
——— ——— *Assistant in Analytical Chemistry*
Charles A. Harper, Ph.D., *Assistant in Organic Chemistry*
Leon Laizer Watters, B.S., *Assistant in General Chemistry*

Officers of Other Departments Giving Instruction in this Course

Professors

J. Howard Van Amringe, Ph.D., L.H.D., LL.D., *Professor of Mathematics*
Ogden N. Rood, A.M., *Professor of Physics*
Frederick R. Hutton, E.M., Ph.D., *Professor of Mechanical Engineering, and Delegate to the University Council*
Alfred J. Moses, E.M., Ph.D., *Professor of Mineralogy*
William Hallock, A.B., Ph.D., *Adjunct Professor of Physics*
*Francis B. Crocker, E.M., Ph.D., *Professor of Electrical Engineering*
Robert S. Woodward, C.E., Ph.D., *Professor of Mechanics*
Henry M. Howe, A.M., S.B., *Professor of Metallurgy*

*Absent on leave.

INSTRUCTORS

Ralph E. Mayer, C.E., *Instructor in Drawing*
James Maclay, C.E., *Instructor in Mathematics*
Reginald Gordon, A.B., *Instructor in Physics*

TUTORS

Joseph Struthers, Ph.D., *Tutor in Metallurgy*
Joseph C. Pfister, A.M., *Tutor in Mechanics*
Lea McI. Luquer, C.E., Ph.D., *Tutor in Mineralogy*
Herschel C. Parker, Ph.B., *Tutor in Physics*
Jonathan B. Chittenden, Ph.D., *Tutor in Mathematics*
Charles C. Trowbridge, B.S., *Tutor in Physics*
Cassius Jackson Keyser, A.M., *Tutor in Mathematics*
Frank Leo Tufts, Ph.D., *Tutor in Physics*

ASSISTANTS

Herbert P. Whitlock, C.E., *Assistant in Mineralogy*
Henry S. Curtis, A.B., *Assistant in Physics*
Herbert T. Wade, A.B., *Assistant in Physics*
Parker C. McIlhiney, Ph.D., *Assistant in Metallurgy*
Thomas H. Harrington, C.E., *Assistant in Mechanical Engineering*
Theodore G. White, Ph.B., A.M., *Assistant in Physics*
Dana C. Wells, A.B., E.E., *Assistant in Physics*
William S. Day, Ph.D., *Assistant in Physics*
William Claflin Andrews, E.E., *Assistant in Physics*
Richard S. McCaffery, M.E., *Assistant in Metallurgy*
Walter W. Cook, A.B., *Assistant in Mathematics*
Henry B. Mitchell, E.E., *Assistant in Mathematics*

GENERAL STATEMENT

The regular four-year courses of instruction herein shown are designed for the education of professional chemists who intend to devote their lives to the practice of this profession, either as teachers in colleges and scientific schools, or as experts or managers in manufacturing and other industrial enterprises.

There are three parallel courses offered, each leading to the degree of Bachelor of Science:

Course A.—Analytical Chemistry
Course B.—Industrial Chemistry
Course C.—Organic Chemistry

The subjects taught are very much the same in the three courses, but special attention is devoted in each course to that branch of chemistry which characterizes it.

The courses of instruction include not only all branches of theoretical, analytical, and industrial chemistry, but also of the other collateral sciences which have been found by experience to be required by the professional chemist, such as mathematics, physics, crystallography, mineralogy, microscopy, bacteriology, metallurgy, and drawing. It is the intention to provide the graduate, not only with a thorough knowledge of the principles and practice of chemistry in all its branches, but with such a broad and liberal education in the collateral sciences as will prepare him for every demand that will be likely to be made upon him in after-life in connection with his profession, and also to enable him to become an investigator.

The instruction is by lecture, recitation, and laboratory practice, with periodical examinations, both written and experimental. Special attention is given to new methods of analysis, and to synthetic work in the organic laboratory.

Special Students

are admitted for studies in chemical subjects ; only, however, when they are sufficiently mature and sufficiently advanced to qualify them to pursue such studies in chemistry with advantage.

University Students

are also admitted to chemical studies for the degrees of Master of Arts and Doctor of Philosophy, or for special study.

EQUIPMENT

In the new Havemeyer Hall, the Chemical Department is provided with ample space for its museum, lecture-rooms, and laboratories, and every possible convenience has been provided for both the instructors and students working in the general or special courses.

There are five chemical lecture-rooms, all fully supplied with apparatus and instruments, and equipped lavishly with pneumatic troughs, gas, pressure, exhaust, and electricity. The large chemical lecture-room on the ground floor contains 316 seats, and is the largest and handsomest lecture-room in the University. Underneath the rear of this room is situated a large store-room for lecture apparatus, and connected with it are convenient rooms for preparing the lecture experiments.

The Museum of General Inorganic and Organic Chemistry and of the Chemical Arts, a large and lofty room occupying the whole left wing of the ground floor, contains the elements and all their more important compounds ; representative sets of specimens of all classes of organic compounds ; materials and products illustrating the chemical arts, and numerous models, pictures, and diagrams, illustrating the various branches of the science of chemistry.

The Qualitative and General Chemistry Laboratory is equipped with ninety-six desks, each divided into two sections, for use by different students, and each equipped with sink and water faucet, gas, exhaust, and electric light. The laboratory has been entirely refurnished with new and handsome sets of imported reagent bottles. In the General Chemistry Laboratory, the students of Columbia College and the other schools who select this course as an option, are taught, in a thorough manner, to prepare the more important elements and their inorganic compounds, and to study the principal physical and chemical properties of the same.

In the Qualitative Laboratory, principally used by the students in the Schools of Pure and Applied Science, the reactions of the various metals and salts are taught largely with a view to their separation and identification. The students first learn the properties of the individual members of a single group of acids and bases. Then single members or mixtures of members of this group are submitted to them for identification; and finally, proceeding from simple to complex substances, they become able to determine the composition of the most difficult mixtures.

The Quantitative Laboratory is equipped with seventy-two desks, each one provided with gas, water, pressure, exhaust, and electricity, besides electric lights. The students first analyze substances of known composition, such as crystallized salts, so that they may constantly check the accuracy of their work by reference to the true percentage composition. Then they proceed to more complex analyses of materials that they would be apt to meet with in their actual practice, such as ores, metals, and minerals, and a great range of commercial articles, both organic and inorganic, such as gas, water, food products, and the like. Attached to the main laboratory is a large and well-equipped balance room, containing accurate balances, and special rooms, which are now being equipped with the latest and most improved apparatus for gas, water, and electrolytic analysis.

The Organic Laboratory contains forty large and commodious desks, each one provided with water, gas, pressure, exhaust, and electricity. The laboratory is also provided with high and low-pressure steam, and with special rooms for balances, pressure ovens, glass-blowing, combustions, and for advanced work in various directions. It is thoroughly equipped with all necessary apparatus and instruments for the determination of boiling-points, melting-points, specific gravities, vapor densities, for proximate and elementary analyses, and for the synthetic preparation of organic compounds.

The Laboratory of Industrial Chemistry is planned for the instruction of students in the practical operations of chemical manufactures and chemical industries, and in the solution of various important problems in sanitary chemistry and hygiene. It is equipped for the manufacture of pure chemicals from their raw materials on an industrial scale, with fine batteries of steam evaporators, and with steam stills, centrifugals, filter presses, crushers, and the like. It includes a dyeing laboratory supplied with a large stock of the most important natural and artificial dye-stuffs, and with all the regular equipment used in the practical testing of dyes, including a calico-printing machine. Connected with it is a photometer room, containing a new and complete outfit for the practical testing of illuminants. Among the other subjects in which practical instruction is to be given in this laboratory may be mentioned the filtration and purification of water and sewage, fermentation and distillation, the use of the electric furnace, and the manufacture of sugar, petroleum products, and leather.

The new Laboratory of Physical Chemistry is well equipped with the most recent apparatus adapted to a wide range of experimental work in the branches of heat, light, and electricity as applied to chemical problems. The students take up the subject in the second year with special reference to the behavior of substances in solution. In their fourth year they resume the subject from a more advanced standpoint, and, with the aid of the higher mathematics, attack problems of broader range and greater difficulty. Towards the end of their course a simple original investigation is undertaken, which, if successful, is published by the student.

The Assay Laboratory is provided with crucible and muffle furnaces, both gas and coal, for the fire assay of ores; also with crushing, pulverizing, and sampling machinery, balance room, store-room, and thirty-six well-equipped working desks. It also contains all the apparatus necessary for the wet assay of silver bullion and for laboratory tests of ores.

EXCURSIONS AND SUMMER WORK

During the session the students will visit the chemical works, electrical and metallurgical establishments of the city and its environs.

During the summer vacations drawings or memoirs, on subjects which will be assigned, are required, as well as reports upon chemical works and manufactories which will be visited in company with the Instructors in Industrial Chemistry. The time specified for the completion and handing in of the memoirs is November 1st of each year.

The drawings or memoirs must be accompanied with translations, of greater or less length, from French and German text-books or scientific periodicals, upon subjects assigned to each student.

COURSE OF INSTRUCTION

First Year

Identical for the three Chemical Courses

First Half-year

TRIGONOMETRY (Mathematics X)—5 hours, first part of half-year. Mr. MACLAY, Dr. CHITTENDEN, and Mr. KEYSER

ALGEBRA (Mathematics X)—5 hours, second part of half-year. Mr. MACLAY, Dr. CHITTENDEN, and Mr. KEYSER

PHYSICS (Physics I)—3 hours. Professor ROOD and Mr. GORDON

CHEMISTRY (Chemistry I)—4 hours. Professor CHANDLER, Professor PELLEW, Dr. LAUDY, Mr. TUCKER, and Mr. WHITAKER

EXPERIMENTAL CHEMISTRY (Chemistry VI)—2 hours, and 4 afternoons and Saturdays of alternate weeks, laboratory. Professor PELLEW, Dr. WELLS, and Assistants

BLOWPIPE ANALYSIS (Mineralogy I)—1 hour, and afternoons of alternate weeks, laboratory. Professor MOSES, Dr. LUQUER, and Mr. WHITLOCK

CRYSTALLOGRAPHY (Mineralogy II)—2 hours. Professor MOSES

DRAWING (Mechanical Engineering I)—1 hour, and drawing-room. Mr. MAYER and Mr. HARRINGTON

Second Half-year

ANALYTICAL GEOMETRY (Mathematics XI)—5 hours. Mr. MACLAY, Dr. CHITTENDEN, and Mr. KEYSER

PHYSICS (Physics I)—3 hours. Professor ROOD and Mr. GORDON

CHEMISTRY (Chemistry I)—4 hours. Professor CHANDLER, Professor PELLEW, Dr. LAUDY, Mr. TUCKER, and Mr. WHITAKER

QUALITATIVE ANALYSIS (Chemistry VII)—2 hours, and 4 afternoons and Saturdays of alternate weeks, laboratory. Dr. WELLS and Assistants

MINERALOGY (Mineralogy III)—2 hours, and 3 hours laboratory. Professor MOSES and Dr. LUQUER

DRAWING (Mechanical Engineering I)—Drawing-room practice. Mr. MAYER and Mr. HARRINGTON

Summer Vacation

SUMMER WORK, a set of drawings on subjects to be assigned by the Instructor in Drawing, and other work assigned by the Professor of Chemistry

See pages 15-21 for departmental statements with details of the above courses.

Second Year

Identical for the three Chemical Courses

First Half-year

CALCULUS (Mathematics XII)—3 hours. Professor VAN AMRINGE

PHYSICS (Physics III)—2 hours. Professor HALLOCK

PHYSICAL LABORATORY (Physics III)—2 hours. Professor HALLOCK

ORGANIC CHEMISTRY, ELEMENTARY (Chemistry XX)—3 hours. Mr. BOGERT and Dr. HARPER

INDUSTRIAL CHEMISTRY (Chemistry XXIV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

QUANTITATIVE ANALYSIS (Chemistry IX)—4 hours, and 4 afternoons and Saturdays laboratory. Professor RICKETTS and Dr. MILLER

MINERALOGY (Mineralogy III)—2 hours, and 3 hours laboratory. Professor MOSES and Dr. LUQUER

Second Half-year

CALCULUS (Mathematics XII)—3 hours. Professor VAN AMRINGE

PHYSICAL LABORATORY (Physics III)—2 hours. Professor HALLOCK

ORGANIC CHEMISTRY, ELEMENTARY (Chemistry XX)—3 hours. Mr. BOGERT and Dr. HARPER

INDUSTRIAL CHEMISTRY (Chemistry XXIV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

PHYSICAL CHEMISTRY (Chemistry III)—2 hours, and 2 hours laboratory. Dr. MORGAN

QUANTITATIVE ANALYSIS (Chemistry IX)—4 hours, and 4 afternoons and Saturdays laboratory. Professor RICKETTS and Dr. MILLER

Summer Vacation

SUMMER SCHOOL IN CHEMISTRY, and Memoir on some subject to be assigned by the Professor of Chemistry

See pages 15–21 for departmental statements with details of the above courses.

Third Year

COURSE A.—ANALYTICAL CHEMISTRY
COURSE C.—ORGANIC CHEMISTRY

First Half-year

THEORETICAL MECHANICS (Mechanics III)—2 hours. Mr. PFISTER

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

INDUSTRIAL CHEMISTRY, LABORATORY (Chemistry XXVI)—3 afternoons. Professor PELLEW and Mr. TUCKER

ASSAYING (Chemistry XVII)—3 hours, and 2 afternoons and Saturdays laboratory. Professor RICKETTS, Dr. MILLER, and Mr. FULTON

GENERAL METALLURGY (Metallurgy I)—3 hours for three months. Dr. STRUTHERS

METALLURGY OF IRON AND STEEL (Metallurgy II)—3 hours for one month. Professor HOWE

METALLURGY OF LEAD, ETC. (Metallurgy V)—3 hours for one month. Dr. STRUTHERS

Second Half-year

THEORETICAL MECHANICS (Mechanics III)—2 hours. Mr. PFISTER

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

QUANTITATIVE ANALYSIS (Chemistry XIII)—4 hours, and 4 afternoons and Saturdays laboratory. Professor RICKETTS and Dr. SHERMAN

METALLURGY OF LEAD, ETC. (Metallurgy V)—3 hours. Dr. STRUTHERS

Summer Vacation

SUMMER SCHOOL IN CHEMISTRY, and Memoir on some subject to be assigned by the Professor of Chemistry

SUMMER SCHOOL IN METALLURGY

Third Year

COURSE B.—INDUSTRIAL CHEMISTRY

First Half-year

THEORETICAL MECHANCIS (Mechanics III)—2 hours. Mr. PFISTER

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

INDUSTRIAL CHEMISTRY, LABORATORY (Chemistry XXVI)—3 afternoons. Professor PELLEW and Mr. TUCKER

ASSAYING (Chemistry XVII)—3 hours, and 2 afternoons and Saturdays laboratory. Professor RICKETTS, Dr. MILLER, and Mr. FULTON

GENERAL METALLURGY (Metallurgy I)—3 hours for three months. Dr. STRUTHERS

METALLURGY OF IRON AND STEEL (Metallurgy II)—3 hours for one month. Professor HOWE

METALLURGY OF LEAD, ETC. (Metallurgy V)—3 hours for one month. Dr. STRUTHERS

Second Half-year

THEORETICAL MECHANICS (Mechanics III)—2 hours. Mr. PFISTER

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

INDUSTRIAL CHEMISTRY, LABORATORY (Chemistry XXVII)—2 afternoons. Professor PELLEW and Mr. TUCKER

QUANTITATIVE ANALYSIS (Chemistry XIII)—4 hours, and 3 afternoons and Saturdays laboratory. Professor RICKETTS and Dr. SHERMAN

METALLURGY OF LEAD, ETC. (Metallurgy V)—3 hours. Dr. STRUTHERS

Summer Vacation

SUMMER SCHOOL IN CHEMISTRY, and Memoir on some subject to be assigned by the Professor of Chemistry

SUMMER SCHOOL IN METALLURGY

Fourth Year

COURSE A.—ANALYTICAL CHEMISTRY

First Half-year

ELEMENTARY THERMODYNAMICS (Mechanics V)—2 hours. Mr. PFISTER

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

ANALYTICAL CHEMISTRY (Chemistry XIV)—2 hours. Professor RICKETTS

ORGANIC CHEMISTRY (Chemistry XXI)—4 hours, and at least 22 hours laboratory. Mr. BOGERT and Dr. HARPER

PHYSICAL CHEMISTRY (Chemistry IV)—3 hours. Dr. MORGAN

ELECTRO-CHEMISTRY (Electrical Engineering III)—1 hour. Professor CROCKER

METALLURGY OF COPPER (Metallurgy IV)—3 hours for three months. Professor HOWE

Second Half-year

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

INDUSTRIAL CHEMISTRY, LABORATORY (Chemistry XXVII)—2 afternoons. Professor PELLEW and Mr. TUCKER

ANALYTICAL CHEMISTRY (Chemistry XIV)—2 hours, and 3 afternoons and Saturdays laboratory. Professor RICKETTS, Dr. MILLER, and Dr. SHERMAN

ORGANIC CHEMISTRY (Chemistry XXI)—3 hours. Mr. BOGERT and Dr. HARPER

PHYSICAL CHEMISTRY (Chemistry IV)—3 hours, and 1 laboratory exercise. Dr. MORGAN

ELECTRO-CHEMISTRY (Electrical Engineering III)—1 hour. Professor CROCKER

THESIS, on some Chemical subject approved by the head of the department

Fourth Year

COURSE B.—INDUSTRIAL CHEMISTRY

First Half-year

ELEMENTARY THERMODYNAMICS (Mechanics V)—2 hours. Mr. PFISTER

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

ORGANIC CHEMISTRY (Chemistry XXI)—4 hours, and at least 22 hours laboratory. Mr. BOGERT and Dr. HARPER

PHYSICAL CHEMISTRY (Chemistry IV)—3 hours, and 1 laboratory exercise. Dr. MORGAN

ELECTRO-CHEMISTRY (Electrical Engineering III)—1 hour. Professor CROCKER

ENGINEERING OF POWER PLANTS (Mechanical Engineering XII)—2 hours. Professor HUTTON

METALLURGY OF COPPER (Metallurgy IV)—3 hours for three months. Professor HOWE

Second Half-year

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

INDUSTRIAL CHEMISTRY, LABORATORY (Chemistry XXVIII)—5 afternoons. Professor PELLEW and Mr. TUCKER

ORGANIC CHEMISTRY (Chemistry XXI)—3 hours. Mr. BOGERT and Dr. HARPER

ELECTRO-CHEMISTRY (Electrical Engineering III)—1 hour. Professor CROCKER

PHYSICAL CHEMISTRY (Chemistry IV)—3 hours. Dr. MORGAN

ELECTRICAL ENGINEERING (Electrical Engineering V)—1 hour, and 2 hours laboratory. Professor CROCKER

ENGINEERING OF POWER PLANTS (Mechanical Engineering XI and XIII)—3 hours. Professor HUTTON

THESIS, on some Chemical subject approved by the head of the department

Fourth Year

COURSE C.—ORGANIC CHEMISTRY

First Half-year

ELEMENTARY THERMODYNAMICS (Mechanics V)—2 hours. Mr. PFISTER

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

ORGANIC CHEMISTRY (Chemistry XXI)—6 hours, and at least 22 hours laboratory. Mr. BOGERT and Dr. HARPER

PHYSICAL CHEMISTRY (Chemistry IV)—3 hours. Dr. MORGAN

ELECTRO-CHEMISTRY (Electrical Engineering III)—1 hour. Professor CROCKER

PHYSICAL CRYSTALLOGRAPHY (Mineralogy VIII)—1 hour laboratory. Dr. LUQUER

Second Half-year

INDUSTRIAL CHEMISTRY (Chemistry XXV)—4 hours. Professor CHANDLER, Professor PELLEW, and Dr. LAUDY

INDUSTRIAL CHEMISTRY, LABORATORY (Chemistry XXVII)—2 afternoons. Professor PELLEW and Mr. TUCKER

ORGANIC CHEMISTRY (Chemistry XXI)—5 hours, and 3 afternoons and Saturdays laboratory. Mr. BOGERT and Dr. HARPER

PHYSICAL CHEMISTRY (Chemistry IV)—3 hours, and 1 laboratory exercise. Dr. MORGAN

ELECTRO-CHEMISTRY (Electrical Engineering III)—1 hour. Professor CROCKER

THESIS, on some Chemical subject approved by the head of the department

DEPARTMENTS OF INSTRUCTION

COURSES IN CHEMISTRY

I—GENERAL INORGANIC CHEMISTRY—Introduction. Laws of chemical combination, history, occurrence, preparation, and properties of the elements and their principal compounds. Text-book: Newth's Inorganic Chemistry. 3 lectures and 1 recitation a week, or 1 laboratory exercise. Professor CHANDLER, Professor PELLEW, Dr. LAUDY, and Mr. WHITAKER

Required of all first-year students in the Schools of Mines, Chemistry, and Engineering. Open as an elective to Sophomores, Juniors, and Seniors in Columbia College, with three lectures and one afternoon in the laboratory.

Laboratory practice comprises the preparation, physical and chemical properties and tests of the principal inorganic elements and compounds. Text-book: Pellew's Laboratory Exercises in General Chemistry. 1 laboratory exercise a week for the entire year. Professor PELLEW and Mr. WHITAKER

Required of Columbia College students who elect Chemistry I.

II—GENERAL INORGANIC CHEMISTRY—Introduction. Laws of chemical combination, history, occurrence, preparation, and properties of the elements and their principal compounds. Text-book: Newth's Inorganic Chemistry. 2 lectures a week throughout the year. Professor PELLEW

Laboratory practice comprises the preparation, physical and chemical properties and tests of the principal inorganic elements and compounds. Text-book: Pellew's Laboratory Exercises in General Chemistry. 2 afternoon exercises in the laboratory and 2 conferences a week for half the year. Half the class during the first half-year; the other half during the second half-year. Dr. VULTÉ, Mr. MATHEWS, and Mr. WATTERS

Required of first-year students in the School of Medicine. Open as an elective to Seniors in Columbia College.

III—PHYSICAL CHEMISTRY—Text-books: Morgan's Theory of Solution and its Results; Ostwald's Scientific Foundations of Analytical Chemistry. 2 lectures a week and 2 hours a week of laboratory work during the second half of the second year. Text-book for the laboratory: Ostwald's Physico-chemical Methods. Dr. MORGAN

Required of all second-year students in the School of Chemistry. Open as an elective to Seniors in Columbia College. Pre-requisite: Chemistry I.

IV—PHYSICAL CHEMISTRY—Energy and energy forms. Photo-chemistry, thermo-chemistry, electro-chemistry; chemical statics; chemical dynamics. Text-books: Ostwald's Allgemeinen Chemie; Naumann's Thermo-chemische Rechnungen; Le Blanc's Electro-chemistry; Ostwald's Physico-chemical Methods, and others. 2 lectures and 1 recitation a week for the entire fourth year, and 1 afternoon in the laboratory during the first half-year for students pursuing the course in Industrial Chemistry, and 1 afternoon in the laboratory during the second half-year for students pursuing the courses in Analytical and Organic Chemistry. Dr. MORGAN

Required of all fourth-year students in the School of Chemistry. Open as an elective to Seniors in Columbia College. Further, open to candidates for the degrees of A.M. and Ph.D., as a minor or major subject. Pre-requisite: Courses I and III.

V—PHYSICAL CHEMISTRY, ADVANCED COURSE—Original research; reports by students upon new work, from the Zeitschrift für Physicalische Chemie and other journals. 2 lectures and at least 12 hours laboratory work a week throughout the year. Dr. MORGAN

Open to candidates for the degree of Ph.D. as a major subject. Pre-requisite: Courses I, III, and IV.

VI—EXPERIMENTAL CHEMISTRY—Conferences and laboratory practice. Text-book: Pellew's Laboratory Exercises in General Chemistry. 2 conferences and 2 laboratory exercises a week for the first half-year. Professor PELLEW, Dr. WELLS, and Assistants

Required of first-year students in the Schools of Mines, Chemistry, and Engineering. Open as an elective to Sophomores, Juniors, and Seniors in Columbia College. Pre-requisite or parallel: Course I.

VII—QUALITATIVE ANALYSIS—Lectures, conferences, and laboratory practice. Text-book: Prescott and Johnson's Qualitative Chemical Analysis. 2 lectures or conferences a week, and laboratory practice during the second half-year. Dr. WELLS and Assistants

Required of first-year students in the Schools of Mines, Chemistry, and Engineering. Open as an elective to Sophomores, Juniors, and Seniors in Columbia College. Pre-requisite: Courses I or II and VI.

VIII—THE SPECTROSCOPE AS APPLIED TO QUALITATIVE AND QUANTITATIVE ANALYSIS—Laboratory practice and conferences with the instructors. 8 hours. Professor RICKETTS and Dr. WELLS

Open to candidates for the degree of A.M. as a minor. Pre-requisite: Courses I, VI, and VII.

IX—QUANTITATIVE ANALYSIS—Text-books: Cairns' Quantitative Analysis and Fresenius' Quantitative Analysis. 2 lectures and 2 recitations a week during the second year, and laboratory practice. Professor RICKETTS and Dr. MILLER

Required of second-year students in the School of Chemistry and the course in Metallurgy. Open to candidates for the degree of A.M. as a major. Pre-requisite: Courses I and VI or VII.

XI—QUANTITATIVE ANALYSIS—Text-book: Cairns' Quantitative Analysis. 1 lecture and 3 hours a week laboratory practice during the first half of the second year. Dr. MILLER and Dr. SHERMAN

Required of second-year students in the course of Electrical Engineering. Pre-requisite: Courses I, VI, and VII.

XII—QUANTITATIVE ANALYSIS—Text-book: Cairns' Quantitative Analysis. 2 lectures a week during first half of the second year, with laboratory practice in alternate weeks during the entire year. Professor RICKETTS, Dr. MILLER, and Dr. JOUËT

Required of second-year students in the courses of Mining Engineering. Pre-requisite: Courses I, VI, and VII.

XIII—QUANTITATIVE ANALYSIS—Proximate organic analysis. 2 lectures, 2 recitations a week, and laboratory practice second half of the third year. Professor RICKETTS and Dr. SHERMAN

Required of third-year students in the School of Chemistry. Open to candidates for the degree of A.M. as a major. Pre-requisite: Course IX.

XIV—SPECIAL METHODS OF COMMERCIAL ANALYSIS—2 lectures a week throughout the year. Laboratory practice during the first half-year for students taking the course in Metallurgy, and the second half-year for students in the course of Analytical Chemistry. Professor RICKETTS, Dr. MILLER, Dr. SHERMAN, and Dr. JOUËT

Required of fourth-year students in the course of Analytical Chemistry. Open to candidates for the degree of Ph.D. as a major, with laboratory work throughout the year. Pre-requisite: Course IX.

XV—SPECIAL AND ADVANCED METHODS IN PROXIMATE ORGANIC ANALYSIS—Research, conferences, and laboratory work at least 20 hours a week. Professor RICKETTS and Dr. SHERMAN

Open to candidates for the degree of Ph.D. as a major. Pre-requisite: Courses IX and XI.

XVI—QUANTITATIVE ANALYSIS, SPECIAL OR NEW METHODS, GRAVIMETRIC, VOLUMETRIC OR ELECTROLYTIC—Conferences and laboratory work at least 12 hours a week for one or two years. Professor RICKETTS and Dr. MILLER

Open to candidates for the degrees of A.M. and Ph.D. as a major. Pre-requisite: Course IX.

XVII—ASSAYING—Ores and metallurgical products. Text-book: Ricketts and Miller's Notes on Assaying. 2 lectures, 1 recitation a week, and laboratory practice. Professor RICKETTS, Dr. MILLER, and Mr. FULTON

Required of all third-year students in the courses of Metallurgy and Chemistry, with laboratory work during the first half-year, three afternoons a week, and on alternate weeks during the entire year for students in the courses of Mining Engineering. Open to candidates for the degrees of A.M. and Ph.D. as a minor.

XVIII—SPECIAL METHODS OF ASSAYING ORES, ALLOYS, AND FURNACE PRODUCTS—Comparison of methods and determination of losses. Professor RICKETTS and Dr. MILLER

Open to candidates for the degree of A.M. or Ph.D. as a minor. Pre-requisite: Course XVII.

XX—ORGANIC CHEMISTRY, ELEMENTARY COURSE—2 hours a week lectures and 1 hour a week recitation. Text-book: Remsen's Organic Chemistry. Mr. BOGERT and Dr. HARPER

Required of all second-year students in the School of Chemistry. Minor for the degree of A.M. Pre-requisite: Course I. Open to Seniors in Columbia College.

XXI—GENERAL ORGANIC CHEMISTRY—In this course the subject is fully treated and the student prepares in the laboratory a large number of organic compounds, besides making elementary analyses and molecular weight determinations. Text-books: Bernthsen's Kurzes Lehrbuch der organischen Chemie; Noyes' Organic Chemistry for the Laboratory; Gattermann's Praxis des organischen Chemikers. During the first half of the fourth year, 3 lectures, 1 recitation, and 22 hours a week laboratory for all students in the School of Chemistry; 2 hours conferences additional for students pursuing the course in Organic Chemistry. During the second half of the fourth year, 2 lectures and 1 recitation a week for students pursuing the courses in Industrial Chemistry or Analytical Chemistry; 2 hours conferences and 16 hours a week laboratory additional for students pursuing the course in Organic Chemistry. Mr. BOGERT and Dr. HARPER

Major for the degree of A.M. Pre-requisite: Courses I, III, VI, and IX.

XXII—ADVANCED ORGANIC CHEMISTRY, MINOR COURSES—Any one of the following subjects: (1) Physical properties of organic compounds as related to their molecular constitution; (2) Dissociation coefficients of organic acids; (3) The terpenes and camphors; (4) Synthetic alkaloids; (5) Synthetic perfumes; (6) Synthetic drugs; and such other subjects as may be selected. Personal instruction and laboratory work not less than 12 hours a week. Mr. BOGERT

Minor for the degree of Ph.D. Pre-requisite: Course XXI.

XXIII—ADVANCED ORGANIC CHEMISTRY, MAJOR COURSE—Original investigation and research. Subject to be assigned or approved by the professor. Personal instruction, conferences, private study, and laboratory work. Mr. BOGERT

Major for the degree of Ph.D. Pre-requisite: Course XXI.

XXIV—INDUSTRIAL CHEMISTRY, GENERAL COURSE—The subjects discussed are:—(1) Air: nature, sources of contamination, sewer gas, plumbing, draining, disinfection, ventilation. (2) Water: composition of natural waters, pollution, disposal of sewage and house refuse. (3) Artificial illumination: candles, oils and lamps, petroleum, gas and its products, electric light. (4) Limes, mortars, and cements. (5) Building-stones: decay and preservation. (6) Timber and its preservation: pigments, paints, essential oils, varnishes, preserving processes. (7) Explosives: gunpowder, gun-cotton, nitro-glycerine. (8) Glass and ceramics. (9) Electro-metallurgy. (10) Photography. Text-books: Park's Hygiene and Wagner's Chemical Technology. 3 lectures and 1 recitation a week. Professor CHANDLER and Professor PELLEW

Required of all second-year students in the Schools of Mines, Chemistry, and Engineering. Open to Juniors and Seniors in Columbia College. Pre-requisite: Course I.

XXV—INDUSTRIAL CHEMISTRY, SPECIAL COURSE—The subjects discussed are:—(1) Chemical manufactures: acids, alkalies, and salts. (*a*) Sulphur, sulphurous acid, hyposulphites, sulphuric acid, bisulphide of carbon. (*b*) Common salt, soda ash, hydrochloric acid, chlorine, binoxide of manganese, bleaching powder, chlorates, chlorimetry. (*c*) Carbonate of potash, caustic potash. (*d*) Nitric acid and nitrates. (*e*) Iodine, bromine. (*f*) Sodium, aluminum, magnesium. (*g*) Phosphorus, matches. (*h*) Ammonia salts. (*i*) Cyanides. (*j*) Alum, copperas, blue vitriol, salts of magnesia, baryta, strontia. (*k*) Borates, stannates, tungstates, chromates. (*l*) Salts of mercury and silver. (*m*) Oils, fats, soaps, and glycerine. (2) Food and drink: milk, cereals, starch, bread, meat, tea, coffee, sugar, fermentation, wine, beer, spirits, vinegar, preservation of food. (3) Clothing: textile fabrics, bleaching, dyeing, calico printing; paper, tanning, glue, india-rubber, guttapercha. (4) Fertilizers: guano, superphosphates, poudrettes. Text-books: Wagner's Chemical Technology; Lunge's Manufacture of Sulphuric Acid and Soda; Schultz & Julius' Kuenstlichen Organischen Farbstoffe; Schultz' Chemie des Steinkohlentheers. 3 lectures and 1 recitation for two years, one-half the subject being discussed each year. Professor CHANDLER and Professor PELLEW

Required of third and fourth-year students in the School of Chemistry. Pre-requisite: Course XXIV.

XXVI—INDUSTRIAL CHEMISTRY, LABORATORY PRACTICE—Preparation of chemicals, including solution, filtration, evaporation, crystallization, and distillation, as used in factory practice. 3 afternoons a week during the first half-year. Professor PELLEW and Mr. TUCKER

Required of all third-year students in the School of Chemistry. Open to Seniors in Columbia College. Open as a minor to candidates for A.M. Pre-requisite: Course I.

XXVII—INDUSTRIAL CHEMISTRY, LABORATORY PRACTICE—Special applications: Textile industry, vegetable and animal fibres, bleaching, dyeing, and calico printing. 3 afternoons a week during the second half-year. Professor PELLEW and Mr. TUCKER

Required of third-year students taking the course in Industrial Chemistry, and of fourth-year students taking the courses in Analytical and in Organic Chemistry. Open to Seniors in Columbia College. Minor for the degrees of A.M. and Ph.D.

XXVIII—INDUSTRIAL CHEMISTRY, LABORATORY PRACTICE—Special applications: Water pollution and purification; photometry; electro-metallurgy; fermentation, yeast, beer, wine, spirits, alcohol. 5 afternoons a week during the second half-year. Professor PELLEW and Mr. TUCKER

Required of fourth-year students taking the course in Industrial Chemistry. Open to Seniors in Columbia College. Minor for the degree of A.M. or Ph.D.

XXIX—INDUSTRIAL CHEMISTRY, ADVANCED COURSE—Original research; the study and investigation of methods and processes in sanitary and industrial chemistry. Personal instruction and laboratory work for one year. Professor PELLEW and Mr. TUCKER

Major for the degree of Ph.D. Pre-requisite: A knowledge of General, Analytical, and Industrial Chemistry.

Courses in Electrical Engineering

III—ELECTRO-CHEMISTRY—Including electro-metallurgy; theory and applications of electrolysis and electrical heating; theory and practice of primary and secondary batteries; production, separation, and purification of metals and chemicals. 1 hour a week, fourth year. Professor CROCKER

V—ELECTRICAL ENGINEERING—The principles of electrical engineering and their application to general engineering. 1 hour a week lecture, and 2 hours a week laboratory, second half fourth year. Professor CROCKER

Courses in Mathematics

X—TRIGONOMETRY, PLANE, ANALYTICAL, AND SPHERICAL (Davies' Legendre), and ALGEBRA (Wells' College Algebra) FROM SERIES—5 hours a week, first half first year. Mr. MACLAY, Dr. CHITTENDEN, and Mr. KEYSER

XI—ANALYTICAL GEOMETRY (Wentworth's)—5 hours a week, second half first year. Mr. MACLAY, Dr. CHITTENDEN, and Mr. KEYSER

XII—DIFFERENTIAL AND INTEGRAL CALCULUS (Osborne's)—3 hours a week, second year. Professor VAN AMRINGE

Courses in Mechanical Engineering

I—Elementary Mechanical Drawing—Use of instruments, elementary projections. 1 hour lecture during first half first year, 10 hours drawing academy during the entire year. Mr. Mayer and Mr. Harrington

XI—Engineering of Power Plants—Steam-engines and their mechanisms, rotary engines, the single-acting engine, the mechanical features and construction of the condensing, compound, and multiple-expansion engines. 1 hour lecture with recitation, first half-year; 2 hours a week lectures with recitation, second half fourth year. Professor Hutton

XII—The Steam-engine and its Accessories—The Power Plant continued—Engine valve-gear, details of construction, erection and setting, piping, accessories, and repairs. 2 hours a week lectures with recitations, first half fourth year. Professor Hutton

XIII—The Steam-boiler and its Accessories—The Power Plant concluded—Typical forms, construction, accessories, wear and tear, repairs, tests, inspection, operation, and control. 2 hours a week lectures with recitations, second half fourth year. Professor Hutton

Courses in Mechanics

III—Theoretical Mechanics—Ziwet's Elementary Treatise on Theoretical Mechanics is used as a text. This requires familiarity with the elements of the differential and integral calculus. 2 hours a week, third year. Mr. Pfister

V—Elementary Thermodynamics—The ground covered by this course is indicated by Maxwell's Theory of Heat, which is used as a text. In addition, lectures are given on the more advanced principles and results of the science. 2 hours a week, first half fourth year. Mr. Pfister

Courses in Metallurgy

I—General Metallurgy—As introduction to Courses II, IV, and V. 3 hours a week for three months, third year. Dr. Struthers

II—The Metallurgy of Iron and Steel—3 hours a week during January, third year. Professor Howe

IV—Metallurgy of Copper—3 hours a week during October, November, and December, fourth year. Professor Howe

V—Metallurgy of Lead, Silver, Gold, etc.—3 hours a week for five months, third year. Dr. Struthers

Courses in Mineralogy

I—Blowpipe Analysis—The tests for 40 elements and the qualitative analysis of minerals, alloys, and slags. Afternoons of alternate weeks laboratory, first half first year. Professor Moses, Dr. Luquer, and Mr. Whitlock

II--CRYSTALLOGRAPHY—History, general characters, laws, forms, simple measurements, and calculations. Lectures and conferences 2 hours a week, first half first year. Professor MOSES

III—DESCRIPTIVE AND DETERMINATIVE MINERALOGY—Study of 200 important species, their properties, uses, and methods of determination. 2 hours a week lectures, 3 hours laboratory, second half of first year and first half of second year. Professor MOSES and Dr. LUQUER

VIII—CRYSTALLOGRAPHY—The optical, thermal, electric, and magnetic properties of crystals with experiments ; the geometric form with measurement and delineation ; the effects of mechanical forces. Theories of structure. 1 hour laboratory, first half fourth year. Professor MOSES

Courses in Physics

I—GENERAL PHYSICS—Sound and Heat (first half-year). Light and Electricity (second half-year). 3 hours a week lectures and recitations, first year. Professor ROOD and Mr. GORDON

III—ELECTRICITY (first half-year)—Lectures on absolute system of mechanical and electrical units ; electrical measurements ; the derivation and use of the Ampere, Volt, Ohm, Watt, and Joule. 2 hours a week, second year

LABORATORY WORK IN GENERAL PHYSICS—2 hours a week, entire second year. Professor HALLOCK

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